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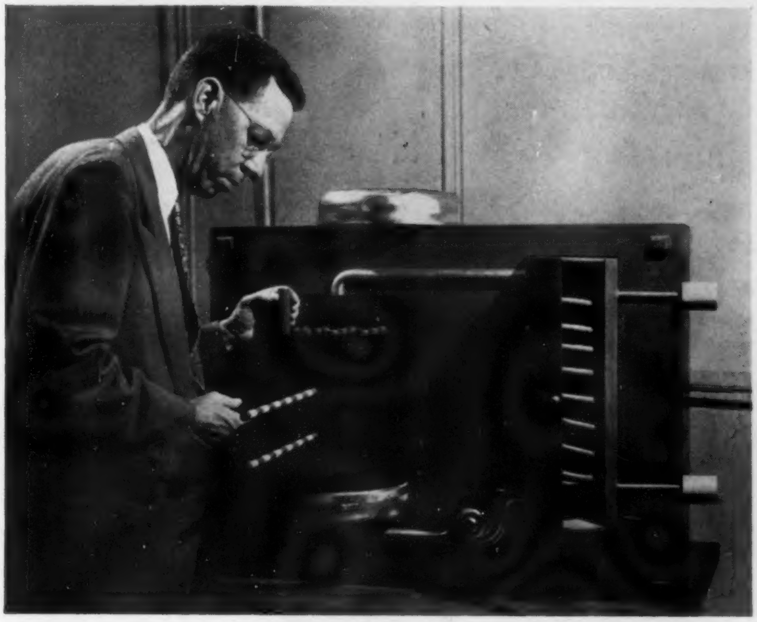

BASIC ELEMENTS OF AN ATOMIC POWER PLANT ARE SHOWN IN THIS MODEL. (See Page 189.) *(Credit: General Electric Company)*

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The Science Teacher

VOLUME XV DECEMBER, 1948 NUMBER 4

Science Problems of National Significance

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THE OFFICE of Education, Federal Security Agency, recently initiated a basic study of science instruction, "An Inquiry into the Teaching of Science, Grades 7-12 (1947-48)", in which questionnaires were sent to 758 public secondary schools of the United States. This is a three percent representative sampling of the four major types of public secondary schools in the 48 states—regular high schools (grades 9 through 12), of which there are 13,844; combined junior-senior high schools (grades 7 through 12), 6,362; senior high schools (grades 10, 11 and 12), 1,319; and junior high schools (grades 7, 8 and 9), 2,656. This study represents the most comprehensive survey of science instruction ever undertaken by the Office of Education.

The response to the questionnaire has been very encouraging to date: 628 completed questionnaires (83 percent of the 758 sent out) have been received. Follow-up will be continued by letter, and finally by telegram until well over 95 percent have been completed and returned.

The final and official tabulation of the results will not be undertaken until the necessary number of selected schools have reported, but preliminary tabulation of some of the data from the 628 replies already in our office has revealed certain facts in regard to the status of science instruction in the secondary schools of the country, which were believed to be true on a national basis, but for which we have had no evidence except from the reports of some scattered state surveys. Some of the more significant of these tentative and preliminary findings are related to the adequacy of the facilities and equipment for the teaching of science courses, to the adequacy of the science staff for the types of courses offered, and to the number and variety of the science offerings. It is in these areas that some of the important problems of science instruction are found.

ALL OF THE major troublesome problems listed[2] by the superintendents, principals and science teachers who answered the question, "Indicate troublesome problems concerning science courses, facilities for instruction, and other conditions relating to the teaching of science in your school" may be grouped arbitrarily into the following five general areas:

(1) Equipment, materials and supplies, listed 201 times as a major problem.

(2) Facilities—rooms, gas, water, electricity, listed 196 times as a major problem.

(3) Teachers — preparation and load—listed 120 times as a major problem.

(4) Little or no science offered, listed 67 times as a major problem.

(5) Textbooks, and supplementary aids, listed 30 times as a major problem.

Problem Area 1—Equipment, Materials and Supplies. If the number of different times a specific problem was mentioned is a valid criterion of its importance then this problem is the one which is causing classroom science teachers the most trouble.

a. Lack of (or obsolete and worn out equipment) was listed 136 times as a major problem.

b. No funds with which to buy equipment —listed by 39 schools as a major problem.

c. Equipment for teacher demonstration but

1—Text of paper given at Summer Convention of the National Science Teachers Association held at Cleveland, Ohio, July 5, 1948. (Modified for publication in *The Science Teacher*).

none for pupil experimentation (13).

d. No laboratory equipment of any kind (11).

e. Insufficient equipment for teacher demonstration (2).

Problem Area II—Facilities. In this category were listed all the problems which related in any way to rooms, laboratories, availability of water, gas, electricity, etc. The returns may be summarized as follows:

a. No laboratory for one or more science courses was listed by 92 schools as a major problem.

b. Water, gas or electricity was not available in 48 of the schools reporting.

c. No special rooms for science classes—use regular classrooms along with other non-science classes (28).

d. No storage space or preparation room (18).

e. No demonstration table (7).

f. Classes held in temporary buildings (3).

Problem Area III—Teachers. The problems in this area are of two general types: (1) those listed by the principals and superintendents who answered the question were concerned with the availability and over-all preparation of science teachers; and (2) those answered by the classroom teacher were concerned primarily with teacher load.

THE MOST pressing problem listed by the administrators was one with which we are all too familiar—the shortage of qualified science teachers. The major problems in this area may be summarized as follows:

a. Shortage of qualified teachers—listed by 68 administrators.

b. Teacher not trained in science—cannot interest pupils, and cannot relate science to significant problems (6).

c. Rapid teacher turnover—loss to industry, bigger schools, etc., (8).

Those problems which were listed by the classroom teachers as being most important were the following:

a. Classes too large—listed 24 times. (Overcrowded conditions were listed many times and if added to this figure would increase its importance considerably.)

b. Too heavy a schedule—no time to take care of equipment and too many different preparations were listed specifically 10 times, but by implication it existed in many more schools than is indicated by this figure.

A summary of the evidence secured in this part of the study would justify the following conclusions:

There is a serious shorage of competent, well-trained science teachers especially in the smaller high schools, where salaries are low, working conditions are unsatisfactory and where in some cases the administration may look with little favor on science courses because of the expense involved in equipping the laboratory or because of the difficulty of scheduling science classes.

The teaching load of the science teacher is heavy. There are relatively few full-time science teachers, and these are found only in the larger high schools. Even here the teachers report little or no free time for taking care of equipment, and also added responsibilities not directly related to the science program.

A COMPARISON between the number of science courses taught in a small or medium sized high school and the number of different teachers who are teaching these courses, reveals the fact that there are many part-time teachers of science in these schools. In many cases two or three teachers are listed as part-time science teachers, but each teacher is responsible for only one or two classes in science. It should be possible to improve the science program in these schools by making one teacher responsible for a larger part of the whole program, rather than dividing the responsibility among several teachers. Such a concentration of responsibility should result in a more integrated and better planned program, a more effective use of the available facilities and equipment, and an enrichment of the science offerings by planning for projects, clubs, and other activities.

Problem Area IV — Little or No Science Offered. The problems which were tabulated in this category were those which resulted in a reduction in the total science program, or in the dropping of science from the curriculum. The specific problems in this area are:

2—From one to five of the problems included in the following tabulations could have been listed by any one school participating in the survey.

a. Conflict in student programs—science offerings reduced to one a year, or two courses which are offered in alternate years, etc., listed by 20 schools.

b. Lack of time for laboratory work (17).

c. No science offered—no teachers available, staff too small, enrollment too small, etc., (15).

d. One year of science in four years (2).

e. Pupils have poor science background—little or no science in elementary or junior high school (14).

Due to the variety and complexity of the problems listed in this category it is difficult to arrive at any definite general conclusions, but a few seem justified.

The total curriculum of the average small high school is crowded as a result of the operation of the process of accretion, the adding through the years of many different courses. The offerings in science, especially in the smaller schools, tend to be crowded out in favor of other courses, which are required by state law or by local preferences and pressures.

There is little evidence of offerings for the talented youth in the form of supplementary courses and units such as are offered in the larger city schools.

Problem Area V—Textbooks and Supplementary Aids. Problems in this area were not listed as many times as might be expected from the criticisms which have been leveled at the textbook in recent years. The major problems related to the basic textbook were these: they are too old, too difficult for the grade level where they are used, not adapted to local problems, and have too few practical problems and practical applications discussed in them.

Problems related to the use of supplementary reading materials were: few are suitable, teacher has no time to survey those available, and crowded conditions do not permit use of classroom library.

A few schools listed problems related to visual aids. These were: no shades for darkening rooms, no equipment, equipment for projection but no film library.

THE RESPONSES to the question "List any science courses that were offered in your school during the school year 1947-48 in addition to general science (7, 8, and 9), biology, chemistry, and physics," furnish a partial answer to the question of what our schools are doing in the way of enriching the offerings in science so as to adjust to differences in the science needs and interests of youth.

The additional courses listed by subject-matter areas are: biology 19, chemistry 4, physics 6, physical sciences 12, aviation 4, other courses (unclassified) 16.

A breakdown of these subject-matter areas into the specific courses mentioned shows the following:

BIOLOGY	No. of Schools Offering
[3]Home Science (9)	6
Physiology	16
Plant Science	1
Horticulture	2
Ag. Projection	1
Agriculture	10
Health (7)	11
Nature Study	2
Home Nursing	2
Domestic Science	2
Life Science	1
Nutrition	1
Botany	3
Zoology	1
Hygiene (7)	1
Hygiene & Genetics	1
Bio. Lab. Techniques	1
Field Biology	1
Conservation	1

CHEMISTRY	No. of Schools Offering
Vocational Chem.	1
Advanced Gen. Chem.	1
Analytical Chem.	1
Applied Chem.	2
AVIATION	
Air Age	2
Pre-Aviation	3
Aeronautics	6
Aviation	1
PHYSICAL SCIENCE	
Consumer Science (11 & 12)	2
Physical Science	4
Senior Science	12
Science for Low I. Q.	1
Science Survey	2
Science Lab. Techniques	1
Hist. & Devel. of Sci.	1
Meteorology	2
Earth Science	1
Applied Science	2
General Science (11 & 12)	4
Practical Science	1

	No. of Schools Offering
Photography	3
Electricity	3
Machines	1
Intro. to Radio	4
Applied Physics	1
Radio Physics	3
OTHER COURSES	
Related Science for Girls	1
Related Science for Boys	3
Vocational Science	4
General Business Science	1
Driver Education	1
Physical Geography	5
Physiography	3
Science Club	1
Mechanical Drawing	1
Surveying	1
Shop Mechanics	1
Auto Mechanics	2
Home Economics	10
Commercial Geog. (9 & 10)	2
Geology	2
Industrial Arts	2

3—Home Science was offered in the 9th grade in 6 of the 628 schools reporting.

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This and That

NORMAN R. D. JONES

President, National Science Teachers Association

President's Report

The various activities of the N.S.T.A., only a few of which are mentioned here, are progressing very nicely according to all reports. Another fine Packet (No. 7) is being processed for mailing as we go to press.

Memberships are coming in every day. Already we have surpassed the half-way mark of last year's totals. However, if we are to achieve the goal we would like to attain, each and everyone of us must renew our efforts tremendously.

The Advisory Council of the Industry-Science Teaching Relations Committee has held several meetings and has reported considerable progress.

The plans for our mid-winter meeting in Washington, D. C., December 27-30 are shaping up very nicely. Those of you who are able to be present for it will be amply repaid for your time and effort.

Our new executive secretary, Mr. Robert H. Carleton, is becoming well acquainted in and out of the office. His services are appreciated by all of us.

Your continued help in all N.S.T.A. undertakings will be appreciated.

Nominating Committee

Dr. Charlotte Grant, Oak Park High School, Oak Park, Illinois, has accepted the chairmanship of this very important committee. All members of the association who care to do so are urged to send Dr. Grant suggestions for officers and members of the board of directors. The other members of the nominating committee are:

Anne E. Burgess	Walter S. Lapp
Elmer Headlee	Edward W. Long
Donald Kumro	Harold E. Wise
Jerome Kuderna	

News

W. B. Buckham, western area regional vice-president, was recently promoted to the head of his science department.

Russell Story, a teacher in the Oak Park, Illinois Township High School and chairman of his school's safety council, represented N.S.T.A. at the National Safety County Meeting in Chicago on October 20.

J. Howard Williamson, Colorado state director, is on leave of absence working toward his doctorate.

Dr. John G. Read of Boston University reported that a very fine conference on elementary school science was recently held there. Dr. Read is also secretary of the New England School Science Council which is responsible for the annual school science contest of that area.

Mr. George Mumford of the Southfield School, Oxford, England, will be an exchange teacher in Transvaal, South Africa, starting December 23. He has arranged to have all N. S. T. A. Membership Services follow along with him. He aims to "tell the story" of N.S.T.A. to all science teachers he meets.

Exchange Teachers

Courtesy memberships in N.S.T.A. for 1948-9 have been extended to the following exchange science teachers:

Mr. Leslie D. Dicker, E. Weymonth, Mass.
Miss Joyce Eldridge, Sioux Falls, S. D.
Miss Dorothy A. Humphries, Syracuse, N.Y.
Mr. Michael E. Malone, Pittsburgh, Pa.
Mr. W. K. Reed, Pittsburgh, Pa.

Our good wishes are extended to them for a memorable year in the N.S.T.A.

Student Memberships

Prof. Vernon C. Lingren of the University of Pittsburgh is helping his student service teachers to get off to a good start through an N.S.T.A. student teaching membership. Thirty-one availed themselves of this service.

Prospective teachers still in school have the privilege of a $1.00 membership fee. N.S.T.A. would appreciate it if more of the teachers in the various colleges and universities would take advantage of this offer.

Oklahoma Science Service

Under the direction of James G. Harlow of the University of Oklahoma there has been

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Source Unit on Atomic Energy

HUBERT J. DAVIS

General Supervisor,
Norfolk County Schools
Portsmouth, Virginia

Objectives

1. To develop a scientific vocabulary which will enable the pupils to understand radio, newspaper, periodical, and other discussions of nuclear energy.

2. To trace the history of the development of nuclear energy and to show that scientists of many nationalities contributed to the project.

3. To show the possibilities of using nuclear energy and its by-products for power, heat, synthesis of new products, and for medical research.

4. To develop an understanding that there are no basic scientific principles which are not generally known by scientists of all countries, that the United States has no permanent monopoly either on the know-how or on the raw materials, and that eventually other nations may develop atomic energy.

5. To develop an understanding that in the present world, peace, war, and industrial progress can be assured only through wise cooperation between the technical scientists and the social leaders.

Principles

1. All matter is made up of one or more of the ninety-two elements which the scientists have known for some time. The scientists have already produced additional elements by splitting the atom, and others may be produced.

2. Atoms are small, light, almost empty shells. Each atom is constructed somewhat like a miniature planetary system.

3. The atom is composed of a nucleus which is very heavy. This nucleus is surrounded by electrons which are extremely light.

4. Atomic nuclei contain protons and neutrons.

5. Many elements have atoms which have the same chemical properties but different atomic weights. These elements are said to have isotopes.

6. When the electrically neutral, fast moving neutron penetrates a nucleus it causes the nucleus to disintegrate. This disintegration is known as fission.

7. Each splitting nucleus of uranium 235 sets free between one and three neutrons.

8. When atoms split they produce isotopes of simpler elements and release great quantities of energy.

9. Mass can be transformed into energy and presumably vice versa.

10. Scientists are able to control the release of atomic energy.

11. The release of heat energy by chemical reaction does not alter the structure of the atom. The release of heat energy by fission taps the energy within the atom and alters its structure.

12. There are definite barriers to the immediate wide use of atomic energy in industry.

13. Great scientific and engineering obstacles have been overcome in releasing atomic energy.

14. Isotopes may be separated by five different methods.

15. The sun's heat and light are produced by atomic disintegration.

Outline of the Unit

I. Nature of the atom and atomic structure.
II. Development of concepts leading to nuclear fission.
III. Obtaining energy from the atom.
IV. The atomic bomb.
V. Scientific and social significance of atomic energy.

Each problem is developed through a series of pupil activities such as reading, discussion, use of audio-visual materials, and creative pupil activities.*

Nature of the Atom and Atomic Structure

1. What are elements? How many are known to exist now? Which elements have been isolated as a result of the fission of the atom?

2. What are atoms? Of what are they com-

*Kits of textual and audio-visual materials have been prepared to meet the needs of the average science group. Since space does not permit listing these nor permit the development of all of the problems in the unit, only problems I and III will be developed. Lists of the materials in the kit and a complete source unit may be obtained from the author.

posed? Do all atoms consist of the same basic building materials? What is the nature of the structure of the atom?

3. What are the parts of the atom? Which are the simpler, and which the more complex parts? What is meant by electron energy? Nuclear energy? Radio-activity? Atomic weight? Atomic number? Periodic classification?

4. What is the heaviest natural element? What is an isotope? Do all elements have isotopes? Which element has the greatest number of isotopes? What is the atomic number of each of the uranium isotopes?

5. What is the law of conservation of matter and energy? Does the release of energy from the atom change the interpretation of this law?

Suggested Activities

1. Have the pupils assemble and examine as many of the elements as possible.

2. Study the periodic classification. Make comparisons between the properties of elements and their placement in the table.

3. Examine an old periodic classification and make comparisons with the up-to-date periodic chart.

4. Draw diagrams of the planetary structure of the atom. Demonstrate the concept of planetary movement with the planetarium. Show the structure of the atom with the atom model.

5. Draw diagrams and make illustrations to show the size of the planetary rings in comparison with the nucleus.

6. Show the first one hundred feet of the film, "*Principles of Electricity*".

7. Read the life stories of Roentgen and of Madame Curie. Obtain an X-ray negative and explain how it was made.

Obtaining Useful Energy From Atomic Fission

1. What steps are now being taken to discover useful properties of atomic energy?

2. Can atomic energy be used to cure disease? If so, how, and which diseases?

3. How are radio-isotopes made? For what are they being used? What is meant by "half-time" tagging elements? How is tagging being used in medical research.

4. Why could the peacetime use of atomic energy be far greater than the military uses?

5. Could atomic energy replace electricity? How does the cost of producing it compare with the cost of energy from coal and other commonly used fuels? What are the possibilities of reducing this cost?

6. What are the possibilities of powering automobiles and other engines with atomic energy? What are the engineering obstacles involved? What type of engine would likely be developed to use atomic energy?

7. How could atomic energy be used in heating water, making steam, heating air, and powering a gas turbine?

8. What are the possibilities of using atomic energy for jet propulsion engines? For rockets? What are the possibilities of using atomic energy to send rocket propelled ships to the moon and through inter-stellar space?

Suggested Activities

1. Draw pictures to illustrate your concept of civilization ten years hence.

2. Draw diagrams to illustrate the use of atomic energy in heating water, air, and in powering engines.

3. Discuss the many extravagant predictions concerning the use of atomic energy.

4. Study the destructive effects of the atomic bomb on Nagasaka, Hiroshima, and Bikini.

5. Make your own designs of defense measures against the use of the atomic bomb.

6. Compile a list of atomic terms and develop simple practical definitions.

7. Prepare a chronological table of the scientific developments leading to the development of fission.

8. Make a list of the recently prepared radio-active isotopes. Find the life span of each, and show how this is important in the treatment of a disease.

9. Collect editorials and magazine articles on the atomic age and evaluate their contents.

10. Make a scrapbook of current information concerning the atomic bomb, nuclear energy, and the nuclear physicists.

11. Make a guide to the reading materials concerning the atomic age.

12. Compare the revolutionary effects of radio, motion pictures, automobile, and the steam engine with the possible effects of the use of atomic energy.

13. Discuss the possible use of atomic energy

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Electric Periodic Chart of the Elements

JAMES R. IRVING
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Des Plaines, Illinois

THOMAS E. SMITH[1]
Park Ridge, Illinois

IN KEEPING with the present-day emphasis on visual aids in curricula, the electric periodic chart of the elements can become the basis of a continuing visual-aid experience in the chemistry lecture room. True to the purposes of any visual-aid technique, this device provides a concrete experience out of which meaningful generalizations of chemistry may grow.

Since the expense and inconvenience of experimenting with a full-sized teaching aid of this type would be practically prohibitive in the average teaching situation, a small portable pilot-size model has been constructed.

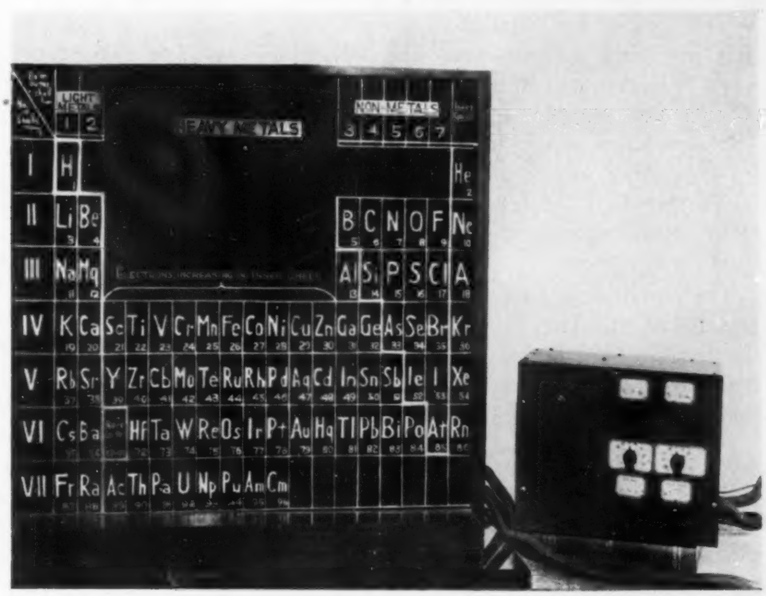
The pilot model is introduced during the opening lectures on the number of elements comprising matter. Pedagogically, it is one thing to talk about the number of metals and non-metals—and another to turn a switch and actually present their position by jewel pilot lights. The electron theory of matter and the structure of the atom are also correlated in this manner.

A widely used modification was employed as the basis of the electric periodic chart.[2] This chart places the periods in the table to show the number of electron shells the atom possesses. Hydrogen and helium in the first period have only one electron layer. Elements in the second period have two layers, and so on. Most of the elements important in the study of elementary chemistry are in the first few periods. As we read down each column or group, elements in each period have one or more electron layers than those in the period above.

THE main panel consists of a self-supporting frame in which is mounted a sheet of 25″ x 25″ plexiglas.[3] The periodic table is painted on this transparent material with translucent paint that glows when illuminated from behind. To accomplish this illumination, a plywood panel is mounted in the same frame a few inches behind the plexiglas and parallel to it. Individual 6-volt, 0.5-ampere flashlight bulbs are arranged on the plywood in jewel pilot light assemblies[4] directly in back

1—With Automatic Electric Company, Chicago, Illinois.
2—*J. Chem. Educ., 16*, 409, (1939)
3—Rodger Kent Company, St. Louis, Missouri.

Continued on Page 184



An electric periodic chart in which individual or groups of elements may be lighted by turning the right switch.

Laboratory First

S. FRED CALHOUN

Township High School
Geneseo, Illinois

THE LABORATORY is the logical place to teach chemistry. There the student must set up apparatus, handle chemicals, conduct experiments, make observations, collect data, and form conclusions. These are but the fundamental ideas of the scientific method which we science teachers are supposed to make a part of the student's thinking.

The usual laboratory manual for high school chemistry is apt to be stereotyped and it fails to give the student much opportunity to develop initiative. Consequently, the teacher must modify and supplement to fit his situation and to give the students an opportunity to really "experiment." If he fails to do this, the laboratory exercise becomes a "follow the directions and fill out the questions" routine which fails to develop any talent or much interest on the part of the student. The teacher must be on the alert to tie the laboratory work to the classroom discussion, and to the life experiences of the student, thus making it meaningful to him.

It is surprising how many experiments the average student can do when free of the laboratory manual. Students are taught to think through an experiment rather than to depend entirely on the manual. This is valuable training.

ONE PHASE of chemistry that is always difficult and of low interest to the student, is that involving mathematics. The laboratory work to accompany this unit of chemistry is also of low interest and needs stimulating. The procedure which follows has been used by the author and is presented in detail. It is illustrated by the reaction between barium chloride and sodium sulfate but is applicable to other reactions.

The equation is first written on the board and balanced. The students then determine the reacting weights of each compound and these are placed under the proper formula, thus

$$\begin{array}{cccc} BaCl_2 + & Na_2SO_4 \rightarrow & BaSO_4 + & 2\,NaCl \\ 208 & 142 & 233 & 117 \end{array}$$

Four labeled bottles are then introduced, each containing the reacting weight in grams of one of the compounds represented and they are placed in the same order as are the compounds in the equation. Their meaning is explained: 208 grams, pounds, or tons of barium chloride reacts with 142 grams, pounds, or tons of sodium sulfate to form 233 grams, pounds, or tons of barium sulfate and 117 grams, pounds, or tons of sodium chloride. The law of conservation of matter may be illustrated by adding the weights of the compounds on each side of the equation.

The class is then asked to give the results if only 20.8 grams of barium chloride were used. Usually there is no trouble getting the correct amounts of the other compounds. Other values are given and worked out in class for drill.

FOR THE next laboratory period, the students are assigned to compute the weights of the other compounds that are needed with a given weight of barium chloride, say five grams. Barium chloride contains water of crystallization which must be considered. Desiccated sodium sulfate is provided. In the laboratory exercise the students weigh out the given amount of barium chloride and the calculated amount of sodium sulfate, dissolve them in distilled water, and mix them. The resulting barium sulfate precipitate is filtered, washed, dried, and weighed. The filtrate and washings are evaporated to dryness and the weight of sodium chloride obtained. It is sufficiently accurate for this experiment to weigh to tenths of a gram.

This experiment is followed by work in volumetric analysis of household ammonia and of vinegar. The students bring samples from home and they are always interested in getting and comparing results. By thus applying the calculations of chemistry to home and laboratory work, mathematics is made more interesting and meaningful to the student.

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Auto Mechanics Course

GEORGE R. DARBY

Fieldston School, New York City

WE WHO teach physics and chemistry are fortunate for many reasons. One of these is the opportunity for participation in a variety of so-called extra-curricular teaching activities, such as science clubs and specialized courses. The teacher of chemistry, as an example .finds himself generally involved with work in photography, mineralogy, or ceramics perhaps; while the physics teacher is in charge of a group in radio, meteorology, or auto mechanics.

I started as a teacher of physics and general science here at Fieldston. I have since developed my own special corner in radio and auto mechanics. My career in the field of auto mechanics started about a month after I became the proud owner of a Ford car. As the car grew older, I became a better mechanic. That car is still with me, now in the mechanics laboratory, teaching others much as it taught me.

THE COURSE had modest beginnings. About five years ago, another teacher and I bought a second-hand Willys-Overland car engine, planning to use it in a general science course. However, two senior boys and I got to it first, and the general science class never did make use of the motor that year. We worked afternoons and free periods in dismantling, assembling and operating it. This proved to be the start of the auto mechanics course at this school.

The following year was the first of the war years, and in the spring there was a week devoted to special pursuits by members of the senior class. Some in the group studied Red Cross first aid, others, machine shop, and a class of nine or ten boys worked with me in a brief survey of car mechanisms, using our Willys engine and other equipment acquired. Such was the interest by then, in this kind of study, that it was decided to enlarge our facilities and organize a class. Accordingly, the next fall we purchased a complete 1932 Buick. A group of senior boys formed a class that met throughout the year, on Saturday mornings. We proceeded to take the car apart outdoors, and eventually brought the entire chassis into our special laboratory. Then, three years ago, the auto mechanics course assumed a more exalted position in the school by becoming a pre-induction minor, which met within the school week. This is the present status of the course.

WE NOW have a wealth of automotive equipment in the laboratory. There are two complete car chasses made up of power plant, power transmission assemblies, running gear, and control apparatus which include the frame, motor, suspension systems, front and rear axle assemblies, steering linkage, braking system, dashboard assembly, complete electrical system, and all parts excepting the body. These two chasses complement each other nicely by providing two types of parts for study. Ford and Buick use different types of suspension systems, shock absorbers, carburetors, and so forth.

Six car engines are available for study, four of which will operate. One is a cutaway or model engine of the variety used in expositions and showrooms, and is an extremely useful teaching device. The group includes an "in-line", a "V" type, and a radial type (motorcycle) engine.

The auto mechanics minor meets once a week, for a two hour session. In that time there is a discussion period and a longer laboratory period. The primary function of the course is to study the makeup, functioning, adjustment, and maintenance of car mechanisms. The laboratory phase of the work, therefore, is of paramount importance.

In the laboratory the class is divided into groups of two to four students. The present class consists of four such groups. I have found it a real improvement this year to have all groups work on the same type of car part at the same time, i.e., all on brake mechanisms, all on clutches, and so forth. There is enough equipment in the laboratory to supply four of nearly all important automotive assemblies.

A GROUP will spend two weeks on any one type of part, and in that time it is possible

for the boys to work on two or three examples of it as, for instance, the clutch mechanisms of the Ford, Buick, and Willys. Rotation of group assignments insures each student a chance at all laboratory activities.

Home reading assignments are given that parallel the laboratory work, and these are adjusted to fall in between the two class sessions devoted to the study of the unit. The advantage of this arrangement is the fact that a student meets a new assembly first in the laboratory and becomes acquainted first hand with the parts that make it up, becomes aware of what he does not know about the apparatus, and so makes more meaningful the reading assignment that comes before he next meets the problem in the laboratory.

A GROUP assigned a problem follows a simple pattern in the study of the assembly. First the student must see the relation of the part to the rest of the car; for example, the transmission is located in the "power train" from motor to rear wheels between the clutch and the universal joint at the front end of the propeller shaft. The part is then extracted, taken to a lab work table, and there becomes a "bench job". Here the part is dismantled with considerable care and thought, using proper tools and techniques and with as little assistance as possible. A record is kept of the steps involved. When apart, the intelligent student will be able to determine the probable operation of the transmission. He will see how gear positions are shifted, how mechanical advantage is varied in the gear train, the operation of the synchro-mesh clutch and what differences exist between transmissions. The relation between the parts and the names by which they are known are explained at this point. Finally, the entire unit is completely reassembled, even to safety wire and cotter pins. It is then checked by the instructor and put back in place in the car chassis.

AS MENTIONED before, there is a series of reading assignments required of each student. The references we use are U. S. Army War Department technical manuals dealing with auto mechanics. We study carefully the contents of six of these manuals. These are: "Internal Combustion Engine", "Power Transmission Units", "Automotive Brakes", "Automotive Chassis, Body and Trailer Units", "Fuels and Carburetion", and "Automotive Electricity."

The reading in these texts is selected so as to pertain directly to the car units found in most modern cars and especially in the two cars in our laboratory. Since physics is a prerequisite for this course, each student has a good background in fundamentals of machines, hydraulics, electricity, and so forth, and through the laboratory and reading experience the application of physics to the operation of car assemblies is stressed.

Reading assignments are discussed at the beginning of each class meeting, before the lab period. We analyze the important ideas pertaining to the unit, and the principles of physics that explain its operation. A complete cross-sectional line drawing of the structure is put on the blackboard. The discussion centers about this. These diagrams are designed to reveal the essential parts of an assembly necessary for proper operation. Very often these drawings are not strictly accurate from the point of view of placement and precise detail of parts shown. An engineer, I am afraid, would not draw them with these inaccuracies—but a teacher, who stops at nothing and stoops to "most anything to prove a point", would. With the idealized layout of parts, the operation of a complex assembly may be more readily taught.

Certain of our regular diagrams are a combination of structures not usually found in a single car unit. In the study of the carburetor, for example, I include in the same diagram such carburetor members as auxiliary air valve, primary and secondary venturis, metering pin, accelerator well and pump, needle valve, air bleed, and other varieties of compensating devices for operation at different speeds and load conditions.

Students prepare as homework a series of plates, which are diagrams, completely labelled. They are handled much as are physics laboratory reports in that the students are to live up to certain standards of neatness, completeness, and accuracy. These plates become the notebook of each student, serving as a record and summary of the important car units studied. *Continued on Page 182*

Experiments in Illumination

W. E. MILLER

Assistant Professor of Electrical Engineering, University of Illinois

W. E. MILLER

Beginning with this issue Professor W. E. Miller is presenting a series of articles dealing with experiments in illumination. These will be of a very practical nature and useful in the physics class or for project work.

Mr. Miller is Assistant Professor of Electrical Engineering at the University of Illinois. Professor Miller is a member of Eta Kappa Nu, Sigma Xi, Illuminating Engineering Society, American Institute of Electrical Engineers (Past Chairman, Urbana Section), and American Association of University Professors. During World War II he served as Naval Radar Officer in the Airborne Division.

FOREWORD

SUNLIGHT, one of the first phenomena of nature encountered by man, has played a major role in the development of our earth. Without these energy-laden rays, all life would cease to exist. Yet, despite its importance to man, some aspects regarding the true nature of light and its mode of propagation remain a scientific controversy. Until the middle of the 19th century, the accepted theory was that light rays consisted of a stream of corpuscles emanating from a source and traveling in straight lines. This theory seemed entirely satisfactory in explaining the laws of reflection and transmission of light. But, in 1825-1830, it was shown by scientists Fresnel and Young, that the corpuscular theory was not adequate in explaining the phenomena of diffraction and interference of light rays. Basing their work on an earlier postulation by Huygens, these men suggested the acceptance of the "wave" theory as the true means by which light is propagated. Later, Young succeeded in measuring the wavelength and velocity of light and Fresnel explained the phenomenon of diffraction by means of the wave theory. Less than a century ago, the velocity of electromagnetic waves was shown by scientists Maxwell and Hertz to be the same as the velocity of light, indicating that light rays must consist of electromagnetic waves of extremely short wavelengths.

However, since the beginning of the 20th century, Einstein has advanced the theory that the energy of a light ray is propagated in small packages, which he calls photons. In more recent years, A. H. Compton has substantiated this idea by measuring the energy contained in a photon; all of which indicates a need for both theories if all aspects of light are to be explained satisfactorily in terms known to the physicist today.

Meanwhile, man has recently devoted his major attention to the more practical aspects of light, pertaining to increased efficiences of light sources and to the proper utilization of the light radiated by these sources, without regard to the theoretical nature of the element with which he deals.

With this latter aspect in mind, this series of articles has been composed, outlining practical experiments in illumination which the author hopes will stimulate student interest and will prove beneficial to teachers of science in our schools.

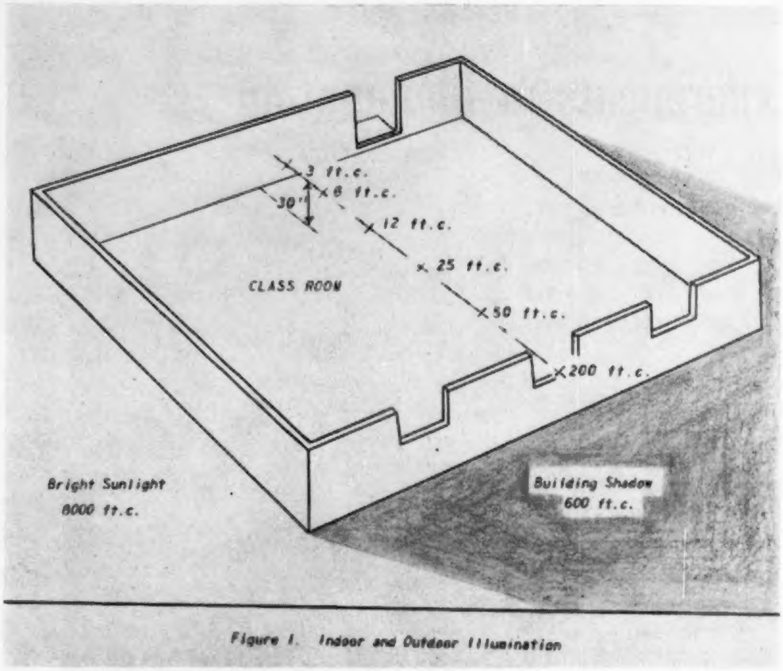


Figure 1. Indoor and Outdoor Illumination

Positions for measuring available light in a room are here indicated.

EXPERIMENT 1.
LEVELS OF ILLUMINATION

Introduction:

The human eye has been compared to a camera. The crystalline lens of the eye performs the same function as the lens of the camera; the iris of the eye compares to the shutter of the camera, and the retina to the film. However, in another respect, they are vastly different in that the ease and the rapidity with which the eye functions far surpasses the action of any mechanism ever devised by man. For example, in passing from bright sunlight into the shade of a building, the eye readily adapts itself to the change in illumination from several thousands of foot-candles[1] to only a few hundred foot-candles. The lens must focus on new objects and the iris must open wider to maintain a constant level of illumination at the retina. Again, as one enters the building, the eye must adapt itself to a lower level of illumination, sometimes not more than a few foot-candles. The operation and versatility of the eye is truly miraculous, especially when one considers the hardships of in-door, usually inadequate, illumination imposed upon the eye. It is little wonder that, in our modern civilization, one's eyes frequently get out of focus, necessitating the use of supplementary lenses in order that the eyes can again make proper adjustment.

Based upon these thoughts, the object of the first experiment is to explore the levels of illumination to which the human eye is subjected.

Recommended Equipment[2]

Foot candle meter similar to the General Electric Light Meter or the Weston Sight Meter.[3]

Floor plan of the classroom.

Procedure

1. If the foot-candle meter is equipped with suitable multipliers[4], measure the level of illumination in the school yard away from all

1—A foot-candle is the unit of illumination and is defined as being the quantity of light on a surface, one square foot in area, spaced one foot from a one candle-power source.

2—In recommending equipment for these experiments, an effort has been made to keep the cost at a minimum.

3—The spectral response curve of the foot-candle meter probably will not agree with that of the human eye, unless the photocell of the meter has been equipped with a suitable filter. Without filters, the two meters recommended have been calibrated to read accurately when used to measure the luminous flux of an incandescent lamp operating at 2700 degrees Kelvin in accordance with recommendations of the Illuminating Engineering Society. When used to measure daylight, a multiplying factor of approximately .80 should be applied to the reading.

4—A multiplier is a metal shield, which, when placed over the cell of the meter, will expose only a fraction of the cell to the illumination to be measured. The meter reading is then multiplied by the inverse of the fraction of the cell's surface exposed.

Continued on Page 164

Science for Society

Edited by JOSEPH SINGERMAN

• A department in which science is presented in its close relationship to the individual and in which guidance is given in causing the individual to recognize the methods of science and its vast social implications.

Nobel Prize Winner on the Atom

It was felt that the following comments on Professor Blackett's recent book were of such timely interest and vital concern to science teachers that permission was sought and obtained to reprint it from the *National Guardian*, published in New York City.—J. S.

In a book just published in London. "The Military and Political Consequences of Atomic Energy," British atomic scientist P. M. S. Blackett has done the most impressive job yet in debunking current atom-warfare legends. Last month Prof. Blackett won the 1948 Nobel Peace Prize. Here are the highlights of his book, as contained in a "Reynolds News" review.—National Guardian.

MANKIND is now in possession of a secret which could, within a measurable period of time, bring up the standard of living of even the most backward countries, like India and China, to the level of the United States.

The problem of raising the standard of living in any country is a problem of raising the total energy available to her. Atomic energy offers this possibility on a scale hitherto unknown.

What prevents us from using it? Mainly, preoccupation with atomic energy as something to be used for mass destruction, as a weapon of war.

"Of course," writes Prof. Blackett, "there are strategic situations in which atomic bombs would certainly have decisive results: but this is true of other weapons, too. It is equally certain that there are strategic situations in which atom bombs would not prove decisive, and it is undeniable that the only important war with the possibility of which the world is now faced (war with Russia) is one of them."

To Blackett, the view held in some military circles—that because one atom bomb has the same destructive effect as 20,000 tons of TNT, therefore one bombing plane can do the job of the number of aircraft hitherto required to carry 20,000 tons of explosives—is an utter fallacy.

SOVIET leaders share his refusal to regard the atomic bomb as a decesive weapon.

If only for this reason, his conclusions are well worth pondering, for they go far to explain why "toughness" as a policy has so far failed to secure results from the Soviets.

They are important, too, because if correct they bear out Prof. Blackett's optimism that "the danger of a third world war in the next few years is much less than is generally thought."

Nevertheless, America's stockpile of bombs will continue to grow, and at some uncertain date Russia's will grow, too, and this may produce a new situation.

The question of control is therefore of vital importance.

WHO IS TO blame for the present deadlock? The general view is that it is Russia's fault. Right or wrong, Prof. Blackett's examination of the Russian attitude, which he is inclined to support, will do service if it restores our capacity to think clearly, rationally and with less hysteria on this ideology-ridden issue.

He quotes various authorities who give at least a strong indication that the atom bomb was dropped on Japan as a diplomatic warning to Russia and, by ending the war quickly, to prevent her troops from reaching Japan first. This, in Prof. Blackett's view, was the beginning of the "'cold war," the first act in the dissolution of the Big Three accord, and accounts much for Russia's suspicions of the West.

Russia's main fear, he says, is that inspection and control as a first measure before prohibition would reveal her secret plants to the U.S.A. without any guarantee that the American stock-pile would be later destroyed.

BUT THERE is also a Russian fear that international control of atomic energy, as visualized by the Americans, would put not only its destructive power, but also its use for industrial purposes, at the mercy of a United Nations body on which the U.S.A. can always command a majority.

Such a body, with power to make allocations of how much each country shall have in the way of atomic plants, could, in this case, put a limit on the Soviet Union's plans for industrial expansion.

In other words, America, which already has the largest amount of total energy at her disposal, might be tempted to curb the efforts of other nations, at present technologically less advanced than she herself is, to raise themselves to the level of the U.S.A.

AND Prof. Blackett quotes plenty of evidence to show that there are powerful interests in the U.S.A. who will obstruct the development of atomic energy for industrial purposes, out of simple fear that the present sources of power, which give the U.S.A. industrial supremacy, will be out-moded.

Blackett's optimism, however, persists. Russia is bound to develop atomic energy anyway, and sooner or later must hold the trump cards. Leaving out the possibility of war in the meantime, America will prefer to have an agreement before this happens. But what about Russia?

It would be a mistake to conclude that Blackett is simply selling us the Russian point of view. He says that there will be no agreement unless Russia changes her attitude no less than the U.S.A. She must give up her demand for the total destruction of all existing atom bombs.

America, on her side, must abandon her insistence, based on the fallacy that the atomic bomb is a decisive weapon, that this bomb should be treated apart from all other weapons.

THE WAY to agreement, says Prof. Blackett, is by general disarmament, in which the atom bomb will be regarded as only one of the weapons of war.

In this general disarmament so many atom bombs might be equated to so many divisions of troops.

Whatever happens, he says, it is no use carrying on discussions on this issue in the way in which they have been conducted during the last two abortive years.—D. R. J.

EXPERIMENTS IN ILLUMINATION

Continued from Page 162

shade. Then measure the illumination in the shade of the school building. On a clear and sunny day, the values obtained will probably agree closely with those shown in Figure 1.

2. With the window shades rolled up and the lights off, take a series of readings in the classroom on desks near the windows, midway from the windows, and farthest from the windows. (Avoid placing the meter in direct sunlight.) Record the readings on the floor plan of the classroom.

3. With the window shades drawn halfway, repeat the procedure of part 2.

4. With the window shades drawn halfway and the artificial lights turned on, repeat the procedure of part 2.

Discussion

FROM the above procedure, the student will observe a large variation in the levels of illumination, not only between outdoor and indoor locations, but also between various locations within the classroom. The student will observe that the illumination level on the desks away from the windows is far below that on the desks nearest the windows. This will show why it is desirable to have the insid row of lights on a separate circuit so that they may be switched on to compensate for the lack of sufficient illumination at these positions.

The minimum illumination recommended for a classroom is thirty (30) foot-candles. Does your classroom measure up to this standard?

Correlations With a Conservation Unit

CHARLES W. COLLINS
Science Teacher

M. A. WIGHT
Principal

Myron T. Herrick Junior High School, Cleveland, Ohio

Introduction

COULD the philosophy of an integrating education be put into practice in Cleveland's junior high schools? How could a faculty be laboratory-minded about these newer educational theories and yet conserve the best traditions of the past? How might the most recent studies of the imperative needs of American youth be implemented in our schools, such as the need to conserve our natural resources?

The Genesis of the Idea

THE ASSISTANT superintendent in charge of curriculum development was chairman of a principals' meeting. In his introductory remarks, the chairman briefly reviewed that significant publication, "Planning for American Youth" of The National Association of Secondary School Principals. This publication recommends the adoption of a "Core Curriculum" in our high schools. After consideration of the many varieties of core curricula, the speaker suggested that the Cleveland Schools might experiment with broad problems, units of work or unifying themes which are chosen because they involve possible co-operation among the subject matter teachers. These subjects would retain their identity, but the content would be taught with special reference to the unit.

One of the participants in the meeting was the science supervisor, who presented the possibilities of correlating the basic content of various subjects with the broad problem of "conservation". This possibility, when associated with the knowledge that two science teachers at Myron T. Herrick had attended the Ohio Conservation Laboratory the previous summer, resulted in the genesis of the project herein described.

The Planning Phase

AT A MEETING of science teachers with the science supervisor, two main problems were discussed. The first problem was that of making the concept of conservation meaningful to pupils. How could pupils be made to grasp the significance of conservation rather than merely memorize certain verbalizations about it? Pupils of junior high age in a large city have had few contacts with problems of the depletion of fertility of the land, of the losses of our nine inches of top soil and cut-over timberland which make conservation a national social problem of major importance. A study of the facts, alone, would not result in effective learning. To make the problem real, plans were made to develop a "Conservation Museum" in one of the classrooms, to renovate the lawn and shrubbery in front of the school and provide a variety of visual materials.

The second problem was that of interesting other subject-matter teachers in the project and inducing them to willingly co-operate in the study of the broad problem. A faculty meeting was planned in which certain teachers presented the possibilities of subject-matter correlation. A trip to visit a science museum in the senior high school was consummated. Individual conferences were held. The advice and encouragement of other supervisors were secured.

AFTER the initial meeting, several weeks were spent in preparing a resource unit—that is, a systematic and comprehensive survey analysis, and organization of possible resources which a teacher might utilize in planning, developing and evaluating a learning unit. Letters were written to authorities on the subject for suggestions. Pamphlets and current magazines were obtained. The librarian secured books and other supplementary reading materials. Visual materials were listed and ordered. An interview was arranged with the director of the Health Museum, also with the county agent.

In addition to these activities, materials were ordered for renovating the front lawn. Plans were made to remove the seats in the

classroom that were to be used for a museum and equipment was requisitioned. Although the planning phase required more time than was expected, it proved to be essential to the success of the experiment.

Activities in Various Subjects and Clubs

The resource unit was the source of the activities undertaken by 8A pupils in their various subjects. An account of these activities follows.

1. The Conservation Museum Club—Twenty five students were members of this club which met during study hall time every day during the whole semester. The museum projects undertaken by various committees of the club provided the *focal* points for the topics studied in the various subjects and thus facilitated learning. Since pupils' purposes are indispensable in the learning process, teacher-pupil planning was used in the selection and work of the projects. The list of projects follows:
   a. Drawing of charts depicting the results of soil erosion.
   b. Making posters showing effects of flood controls.
   c. Preparation of lantern slides.
   d. Selection and procurement of films.
   e. Preparing exhibits showing different types of soils and fertilizers.
   f. Testing samples of soil brought in by students.
   g. Making a poster of the "Conservation Pledge".
   h. Selection of reference material for the library and arranging on a reserve shelf.
   i. Field trips to the Health Museum, the West Tech greenhouse and a department store exhibit.
   j. Printing five varieties of "Conservation Book Marks" which were distributed to 500 pupils.
   k. Writing an article for the school paper.
   l. Printing small cards urging everybody to conserve electricity and placing them above light switches.
   m. Preparing collections of wild flowers, rocks, minerals and insects.
   n. Setting up a fish and wild game display.
   o. Arranging for every class in the school to visit the Conservation Museum.
2. General science.—Activities included acquiring an understanding of the problems involved in conserving topsoil and soil fertility, forests, grasslands, energy, minerals and wild life. From the study of science, pupils learned from whence came our natural resources and how to solve the problem of conserving them for future generations.
3. Social studies.—Activities were selected to create in pupils an increasing ability and willingness to work for conservation as citizens in our democracy. These included a study of the relationship between natural resources and civilization in world history and of possible techniques used by the government in preventing wastage of these foundation building blocks of a culture.
4. English.—Activities included the creating of group compositions to make vivid the meaning of conservation.
5. Mathematics.—Activities undertaken involved computing the amount of soil carried away by flood waters, interpreting maps and degree of slope, and comparing gross yield and net profit between conservation-planned and traditionally handled farms.
6. Art.—Plans were made to build a papier maché model showing a good farm where proper methods of farming have been followed, such as contour plowing and strip cropping, and also a poor farm where no thought was given to the latest scientific methods. Miniature houses, barns, buildings, etc., were constructed.
7. Home economics.—The study of conservation included the relationship between soil, food, nutrition and health.
8. Dramatics.—A special group wrote a play and presented it at a school assembly.
9. Science club.—Activities involved the taking of photographs of various projects and the renovation of the lawn and shrubs in front of the school building.

Continued on Page 186

Audio-Visual Aids

Edited by CHARLES R. CRAKES

The editor of this department will attempt to bring before the readers of this publication the latest articles written by science teachers who are making effective use of various forms of audio-visual teaching materials. He will also endeavor to present a cross-section of educational opinions on audio-visual aids he may gather in travelling about North America.

FOREWORD

Mr. V. S. Keele, author of the first article, "Audio-Visual Problems and Suggestions," is now serving as general science and chemistry teacher at the Sparks Junior High School, Sparks, Nevada. Mr. Keele holds a B.S. Degree from the University of Nevada and has a major in chemistry. He is now doing graduate work in the same institution.

Mr. Keele joined the Navy in the summer of 1942 and remained in that service until January, 1946. During the intervening time he served as navigation instructor to members of air squadrons prior to departure to the South Pacific. In this position he was in full charge of all ground training offered at this particular base.

Upon discharge from the Navy he re-entered the university and continued his work for a graduate degree. He has served in the Sparks Public Schools since the fall of 1946.
—C. R. Crakes.

Audio-Visual Problems and Suggestions

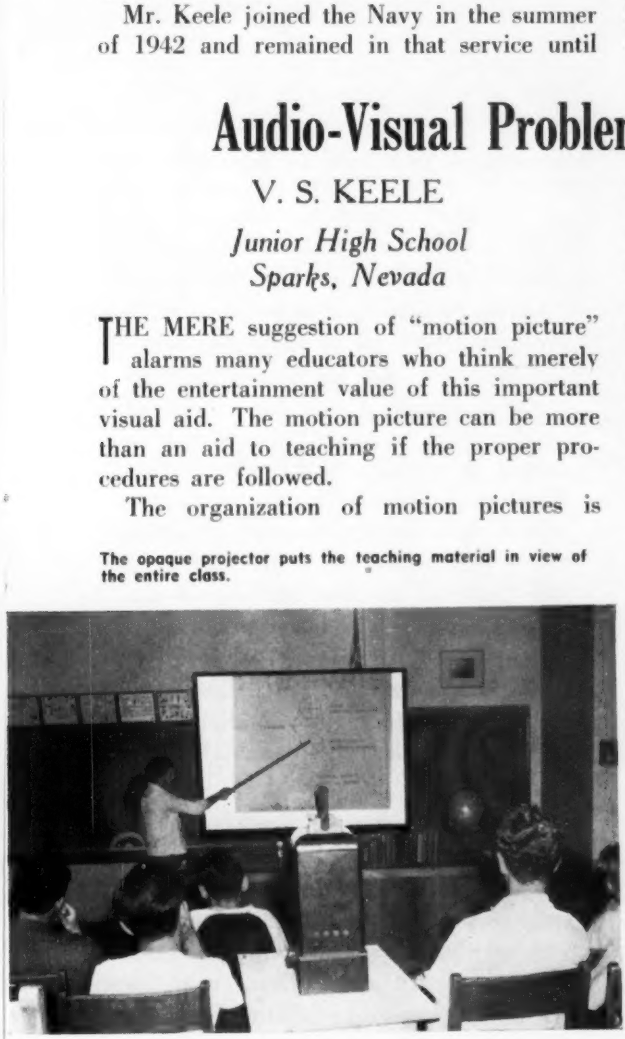
V. S. KEELE

Junior High School
Sparks, Nevada

THE MERE suggestion of "motion picture" alarms many educators who think merely of the entertainment value of this important visual aid. The motion picture can be more than an aid to teaching if the proper procedures are followed.

The organization of motion pictures is under the direction of those especially trained for this work. How can one teacher possibly expect to accomplish these many tasks? The blackboard, which has previously been the teacher's most handy tool for means of illustration cannot possibly hope to equal the illustrations of the world's best artists, and Disney's genius is being utilized extensively in audio-visual materials. The dialogue which accompanies a film is prepared by specialists in the field represented, and the voice is that of one trained for this purpose.

The opaque projector puts the teaching material in view of the entire class.

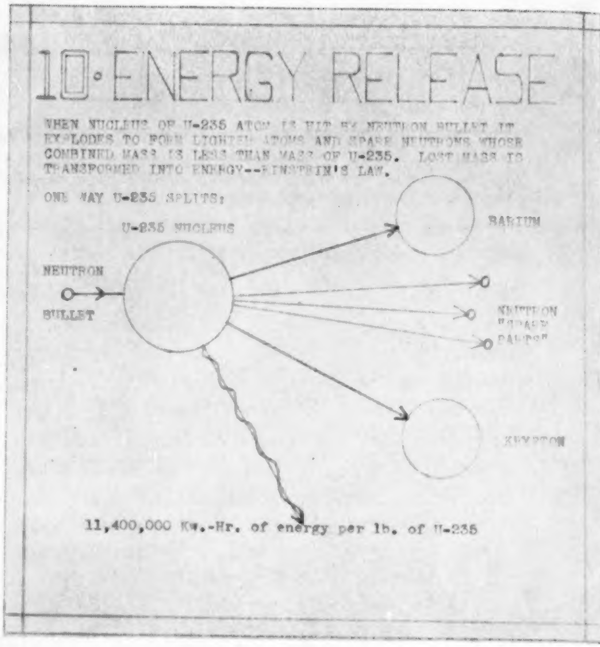


Teaching films can take you, at your convenience, anywhere in the world to see flowers in bloom, wildlife in its natural setting, machines at work, and can cut into the machine to allow complete interior inspection.

THE TEACHER, however, has an even more important responsibility in connection with audio-visual aids. For him a preview of the film is essential. The relation between film shown and the lesson material at hand must be pointed out, and the teacher must be ready to assist in drawing the correct conclusions from the presentation. The most important aspect of a teaching situation is to coordinate all elements and make of them an understandable concrete whole.

To illustrate, let us visualize an example taken from the study of chemistry. A man may know every element of which a compound is composed, but that compound cannot be synthesized by pouring the elemental constituents into a pot, stirring thoroughly and putting the mixture into an oven. The synthesis of each compound requires individual attention on such things as mixing instructions, temperature control, alkalinity and acidity, etc. In the same way, the teacher must pay as much attention to every new problem presented by each film.

To determine the extent and real purpose of these aids in the curriculum requires some creative work on the part of the teacher. It means fitting the aids in with the other material at the appropriate time and place and seeing to it that all available aids of this kind are checked for a purpose and are not merely a means of entertaining the students. Herein may be found the difference between success and failure in the use of audio-visual material.



A careful drawing can be easily and quickly thrown on a screen to make clear a discussion.

THE FILMSTRIP projector should be used as extensively as the motion picture, and it can be used for practically the same purpose. In most cases, however, the motion picture is audio-visual and the filmstrip is a *still* projected aid. This type of material suggests some research work for the teacher in acquiring information and forming a plan of presentation.

One great advantage which the filmstrip has over the motion picture is its lower cost. The filmstrip can usually be purchased for the price that it would take to rent a film. In this way a permanent library may easily be set up with materials which are available at all times.

The high cost of motion picture films is still somewhat of a problem to teachers today. For that reason, it is appropriate at this time to look at some of the companies which produce, free of charge, teaching aids for students and teachers. What is our attitude toward these films? How are we to attain the correct attitude toward the films and companies involved in this project? For an answer to these questions, let us turn to a report from the Michigan Audio-Visual Conference in Detroit. This report was published in SCHOOL AND SOCIETY, May 11, 1946.

"Among the questions to be asked in determining the value of sponsored materials are these: Are the objectives of the material consonant with the educational objectives of the school? Is the material factual and sincere in treatment? Does it present a general or particular point of view? Is it sound in terms of educational philosophy? Is it the best available material for the educational purpose in hand? Is it adapted to the needs, interests, and the maturity level of the students who will use it? Is the sponsor's relationship to the materials clearly known and acceptably stated?

"Educators should beware of accepting audio-visual materials from sponsors who have axe sto grind and, on the other hand, cordially welcome genuinely educational programs produced by sponsors who have axes to grind and, on the other desire to make a significant contribution to the cause of education."

NO ONE CAN deny the educational value of many of the films sponsored by such companies as General Electric and Westinghouse. To allow a defense of this statement we shall quote a Westinghouse sponsor, Mr. Louis M. Stark, who writes in Educational Science:

"Our purpose is to create good will toward Westinghouse and to identify the company as prominent in the fields in which it operates, and to show what part the electrical industry plays in the modern world. Our method of achieving this in the schools is to share our knowledge and experience and attitudes by presenting them to the schools through the most authentic, authoritative and educationally well-designed materials we can produce. Our school service department is staffed with people trained and experienced in teaching and constantly in touch with the activities of the company."

Finally, for many teachers, the opaque projector offers the cheapest means of solving their projection problems. There are many current publications in every phase of classwork which are considered suitable lecture material for a group of students in the secondary schools. However, the lecture method of presentation is too abstract, and the accompanying diagrams in the magazines are always too small for the entire class to see. Also, many times it is not convenient to project the pictures that appear in the book or pamphlet. The teacher has the opportunity, however, of making special cards with the available material copied thereon.

AS AN EXAMPLE of what can be done, I have taken an article from the McGraw-Hill Publishing Company entitled, "The Atom, New Source of Energy." One specific topic included in this article is entitled, "How Atom Splitting Releases Energy." Accompanying this article are two simple and useful diagrams used in picturing the story of the atom. The card is of the size that will easily fit in the opaque projector, and the material and information can be drawn and printed to fit the card. A little extra study on the part of the teacher will allow material, as complicated as atomic energy, to be presented in a manner which will be understood by secondary students.

If used in the correct way, I can see an unlimited value for the opaque projector in all learning situations. With such vivid demonstrations as this to present to our school children, it is not difficult to see the value of visual aids in improving the child's technical skill in his chosen field of endeavor.

Using Slides in the Science Classroom

E. W. CAUGHFIELD

High School, Harlingen, Texas

FOREWORD

Mr. E. W. Caughfield, author of the second article entitled, "Using Slides in the Science Classroom," is now serving as science instructor in the senior high school in Harlingen, Texas.—C. R.. Crakes.

ONE OF MY biggest problems in the teaching of science has always been to get the student to visualize the dimensional structure and movement of normally invisible pieces of matter and elements, such as the atom, the molecule, etc.

The average student has a flat two dimensional picture of four dimensional objects because most teachers can draw only flat pictures on the blackboard for illustration. Teachers generally draw the conventional plus sign in the center and an electron in the outer orbit and tell the students this is a hydrogen atom. Even though we tell the student the hydrogen atom is not exactly like the drawing, he goes out with the picture we put on the board in his mind. Actually the hydrogen atoms look altogether different.

It would be fine if all teachers were artists and could draw a picture to illustrate each point made; but most of us are not, and there is very little we can do about it. But we can take advantage of a teaching tool which is available to all of us, the projector. This

projector is inexpensive enough for all to use, and a vast amount of material may be found.

I use the slide projector to illustrate the molecular theory, the movement of the planets in the solar system, the pollination of plants, etc. In fact a slide or filmstrip can be found to illustrate almost any unit in science. Many of the problems and theories in science which were complex for students now unfold their secrets as each picture is focused on the screen. We have just finished our unit on plant reproduction, and the method used here can, with some modification, be used in any unit in science. After the subject was covered in class discussion, each step in plant reproduction explained and the parts of plants looked at under the microscope, the projector was brought into use and the story was put into pictures.

THE FILMSTRIP used was *Sexual Reproduction in Plants,* from the U. S. Department of Agriculture. Each picture tells its part in the story of plant reproduction beginning with the pollen grain on the stigma of the flower and shows step by step how the pollen tube is formed and how the contents of the pollen grain are emptied into the ovules. Each of these pictures should, of course, be kept on the screen until each student thoroughly understands each step.

One of my students operates the projector and I stand by the screen and point out the various steps that are being explained and answer questions as they come up.

One of my boys summed up the sentiments of the entire class after being unable to understand the cross pollination of plants, when he turned to me after seeing the process explained in pictures and said, "Why didn't you say that?"

Well, the truth was I had in words but I simply cannot talk in pictures.

New Films

By C. R. Crakes

Your Editor has recently previewed several excellent Science films.

The first: HUMAN GROWTH, a 19 minute sound film, in color, produced in 1948 by the University of Oregon, Eugene, Oregon. This film demonstrates for parents how sex education can be handled smoothly; it provides the classroom teacher with a suitable instructional aid for presenting the biological facts of sex as a part of human growth development. It establishes through identification and exemplary teacher-pupil relationship which is conducive to easy classroom discussion.

An excellent film on sex education, suitable for use in the upper elementary grades, junior and senior high school and adult groups. It is suggested that a competent person be available to conduct the discussion whenever the film is used.

The second: THE STORY OF GASOLINE, a 23 minute sound film, in color, produced by the U. S. .Bureau of Mines, Graphic Services Div., 4800 Forbes Street, Pittsburgh 13, Pa. This film combines live action and animation sequences to tell the complete production story of gasoline, from crude oil to the finished product and its uses. Provides a simplified non-technical explanation of the complex structural patterns of petroleum molecules and of the complicated machines and equipment used in the refinery process. Produced by the U. S. Bureau of Mines in cooperation with Standard Oil Co., (Ind.).

The third: GROWTH OF FLOWERS, a 10 minute film, in color, produced by Coronet Instructional Films, Coronet Building, Chicago 1, Illinois. Through the use of time-lapse photography, excellent sequences show the complete cycle of the growth of the garden flowers—iris, rose, and the tropical flowers—gardenia, bird of paradise, and orchid. Excellent photography shows the effect of sunlight on growth.

The fourth: THE HUMAN THROAT, an 11 minute sound film, black and white, produced by Bray Studios, 729 7th Avenue, New York 19, New York. This film describes the throat, including the general anatomy of the pharynx, a description of the larynx and shows the mechanism for opening the vocal cords and the way the larynx closes to permit the passage of food during swallowing.

Edited by MARGARET E. PATTERSON
Secretary, Science Clubs of America

• A department devoted to the recognition of the splendid work being done by science club members and their sponsors. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Miss Patterson, Science Clubs of America, 1719 N Street, N. W., Washington 6, D. C.

National and State Organizations Cooperate to Help Your Science Club

MARGARET E. PATTERSON
Science Clubs of America

SCIENCE CLUBS of America, composed of 15,000 affiliated clubs, is proud to have the following organizations cooperating in providing inspiration and assistance to science clubs in the areas listed below.

Join with them in activities planned for science clubs in your state. Learn about science fairs, state science talent searches, conferences congresses, salons of photography, speakers' bureaus, publications for and by young scientists, science museums, trips to places of scientific interest and radio broadcasts--all planned to give your members more opportunities for science experiences.

Be sure that your club has the chance to participate in all the activities planned just for them in your vicinity. Write to the Cooperator immediately, if you are not fully informed of the program being carried on in your state.

If you live in a state not listed, send your suggestions on how an organization can be found or formed that will perform this highly commendable function of keeping science clubs within the area acquainted and working together in science. Write to Science Clubs of America, 1719 N Street, N. W., Washington 6, D. C. Complete details on all phases of the SCA Program will be sent to you.

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*Plan to hold a State Science Talent Search in 1948-49.

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University of Wisconsin,
Madison 6

*Plan to hold a State Science Talent Search in 1948-449.

Design for Scholarships

By W. F. McLEAN

Secretary
Fisher Body Craftsman's Guild

BOYS IN your science club who are adept at design and construction should be encouraged to test their skills in the annual competition of the Fisher Body Craftsman's Guild. A total of $65,000 in scholarships and other awards await those who enter the competition which ends July 1, 1949.

The required design and construction of a model automobile either from wood or plaster of Paris gives a boy full scope for his imagination and ingenuity. It helps him to learn great precision and provides a stimulus to see a job completed on time.

Two competitions are held each year: one for Juniors, 12 through 15 years of age, and one for Seniors, 16 through 19 years of age. Teams of judges select state and regional winners. The 40 regional winners meet in Detroit in August for the national convention which is the climax of the annual Guild program. A four-day sightseeing tour of Detroit and surrounding points of interest is highlighted by the awards banquet when the scholarship winners are announced.

Looking at their model cars which won for them university scholarships.

Program Appeals to Teachers

Teachers have found the Guild program useful because:

1. The Guild offers boys an actual industrial project to work on. It fascinates most boys and it is keyed to fascinating goals in industry. The Guild also gives boys a complete textbook based on current practice in industry that directs their work in step-by-step order.

2. The Guild gives boys immediate goals as well as long-term goals. Within a single year hundreds of boys can gain public recognition in the arts and crafts of industry, plus cash and other awards, in the Guild's annual competition.

WHEN a boy enrolls he receives a book of instructions on model car design and construction that gives authentic industrial procedures step by step, simplified so they can be followed in the school workshop or at home in the kitchen, if necessary. A few important specifications are enforced so that models will be practical and uniform in size. The scale is one-twelfth full size.

Guild officials agree that the great value of the program lies in the perseverance, ingenuity, manual training, and other character-molding facets that are drawn out of the boy to remain with him all through life. Parents agree, "This is one contest where Johnny wins if he loses."

If you are not already informed on this scholarship competition, write for full details to: Fisher Body Craftsman's Guild, General Motors Building, Detroit 2, Michigan.

If you are not informed on other scholarship competitions open to high school boys

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James Mariol of Canton, Ohio, who won a $4,000 university scholarship in the annual model car competition of the Fisher Body Craftsman's Guild.

Aids to Elementary Science Teachers

DWIGHT E. SOLLBERGER

State Teachers College
Indiana, Pennsylvania

WHILE many school systems have had excellent science programs for many years, under one title or another, others are attempting to introduce science for the first time. The problems that have arisen are many. Many elementary teachers have come to feel that science is the most difficult of all subjects to teach. At a recent conference of science teachers from schools preparing teachers, it was agreed that science was the subject that teachers were most afraid to teach. This is a lamentable situation, and one that cannot be ignored. This article is an attempt to examine some of the problems and to offer some suggestions for their solution. It is obvious that the problems here listed are not the only ones, but from frequent contact with elementary teachers it would appear that they are widespread. The problems which are discussed in this article are as follows:

1. The problem of finding time for science instruction.
2. The problem of introducing a new subject.
3. The problem of space in overcrowded classrooms.
4. The problem of learning the content.
5. The problem of suitable textbooks, courses of study, and supplementary reading material.

The Problem of Finding Time for Science Instruction.

IT IS THE writer's opinion that science should be taught as a separate subject. The problem of time appears when science must be taught with either inadequate time allotments or none, and not when separate periods are provided.

Considerable science may be taught in combination with other subjects such as history and geography. Units may be selected which have scientific, historical, and geographical aspects. In an ideal situation of this kind, it is impossible to tell whether the class is science, history, or geography. At other times, however, such units may be impossible. In such cases, no integration should be attempted. It would appear better to teach separate units than to achieve integration through forced and far-fetched correlations.

Teachers attempting to teach science by this method should make charts showing the different subject aspects of the units. This guards against the possibility of leaving science out in some units because history or geography are more standardized and have been taught longer by the elementary teacher. Such a scope chart is invaluable in planning the work from unit to unit and from grade to grade, giving equal time to the historical or geographical aspects of the units.

In schools where courses are not integrated, time for science instruction must be taken from other subjects. How this is to be done is not in the province of this article, but that science should be a part of the elementary school program in this age of the airplane, radar, guided missiles, atomic energy, and great medical advances is not debatable.

The Problem of Introducing a New Subject.

TO INTRODUCE anything new is always difficult. The teacher will need to be tactful in approaching the problem. It must be remembered that activities such as are suggested in science programs might be considered to be play by parents not acquainted with modern education procedures. School visits should be encouraged and discussions of the problems might take place at parent-teacher groups. Some parents might be asked to make a contribution to the program through some specialty which they have developed. Exhibitions of devices built by the children are helpful in breaking down resistance to experimentation.

The Problem of Space in Overcrowded Classrooms.

SINCE THE science aspects of a problem often require equipment for experimentation, places to store the equipment, and space to perform the experiment, there is the problem of space. A science table is often the most

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Chats With Science Teachers III

Science in the Bible

HANOR A. WEBB

Secretary, National Science Teachers Association

George Peabody College for Teachers

Nashville, Tennessee

(Concluded from the October issue)

THE *Bible* mentions eighteen specific types of *insects* in a considerable number of references. The filthiness of flies is emphasized; a frank comment in *Ecclesiastes* (10:1) is the source of the phrase, "a fly in the ointment". The industry of bees and ants is praised, and the spider's craft appreciated.

In all literature there is no more picturesque passage than the prophet Joel's description of a scourge of locusts—

. . . a day of darkness and gloominess . . . the Garden of Eden before them, and behind them a desolate wilderness . . . like the noise of a flame of fire that devoureth the stubble . . . they shall climb the wall like men of war . . . they shall not break their ranks . . . they shall enter in at the windows . . . (*Joel* 2:2-10).

Locusts are on Moses' "clean list"—perhaps so that the Children of Israel might remove a menace by eating them.

Trees and *wood* rank high in the *Bible's* manuscripts. The most magnificent tree the Hebrews knew was the cedar, which is mentioned 73 times. The oak—probably shrub-like—is referred to in 21 passages. About a score of other trees are mentioned by name. The descriptions of wood in the Scriptures will delight the students of industrial arts. King Solomon's Temple was a masterpiece of construction with fine woods. Chariots and furniture, gallows and crosses—wood served both nobly and ignobly.

ONCE an orchard was planted it had the full protection of Mosaic Law, even though it belonged to an enemy. There are many interesting references, factual and figurative, that lie between Adam's "Tree of Knowledge" in *Genesis* and John's "Tree of Heaven" in *Revelations* with leaves "for the healing of the nations."

Palestine is a rocky land, and the more than 500 *Bible* references to *stones* in general and in particular are appropriate. Stone was much used for foundations, and the foundations of Solomon's Temple may still remain as the noted Wailing Wall in Jerusalem. It is intriguing to think that the Ten Commandments, carved on indestructable stone tablets, may still rest beneath the debris of this same oft-destroyed city.

The chief native stone of Palestine is limestone, hence there are no references to granite or sandstone in the *Bible*. Piles of stones made markers and memorials, (such as Jacob's pillar), wells, tomb walls, and fences. Stones were a means of execution in the cruel "stoning to death"; they also served as ammunition, demonstrated by David who challenged Goliath, and Benjamin's 700 left-handed sling-shot experts.

The three lists of carved and polished gem stones, given in the *Bible*, have suffered from the guesses of King James' translators. For example, the diamond which is mentioned could not have been known in ancient days, since no tools hard enough to engrave it had been devised. The other gems have been given names well known to the jewelers of England, for their true nature was not clear in the Hebrew descriptions.

AND FURTHER—does the *Bible* make reference to winds and weather; to snow and rain; to sunshine and thunder; to rivers, lakes, and the sea; and to the seasons? Do the stars inspire the prophets? Is the moon watched in waxing and waning? Is the farmer, as well as the fisherman, described? Is there advice on how to feed a baby, and on how long an old man may expect to live? Is there any practical limit to the interesting topics, slanted toward science, that may be gleaned by earnest students of the Scriptures?

How may these students be assigned their science searches in the *Bible*? A concordance is a necessity. One is found in the appendix of each better edition of the Book. A complete concordance should be on a library reference shelf. The use of a concordance gives training of value comparable to a similar experience with a dictionary or a thesaurus.

Shall the references, when found, be inter-

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News and Announcements

WASHINGTON CONVENTION

The National Science Teachers Association is serving as host to the science teaching societies affiliated with the American Association for the Advancement of Science in a meeting to be held in Washington, D. C., December 27-30 at the Washington and Willard Hotels. Other societies jointly sponsoring the meeting with N.S.T.A. are American Nature Study Society, National Association of Biology Teachers, National Council on Elementary Science, and Section Q (Education) of A.A.A.S.

A general meeting, jointly sponsored, is held each morning. In the afternoon each society meets separately. Space here permits only a listing of the general topic of each joint session and N.S.T.A. meeting. Individual sessions of other societies have been announced in the publications of these societies respectively. All N.S.T.A. members will receive a complete program.

General Meetings

Morning—Hall of Nations Room, Hotel Washington.

Tuesday—Panel Discussion: Curriculum Development in Science.

Wednesday—Panel Discussion: Problems of Science Teacher Training.

Thursday—The Third Annual Junior Scientists Assembly. Topic: Young Scientists View Science Education for All American Youth.

N.S.T.A. Meetings

2:00 P. M., Hall of Nations Room, Hotel Washington.

Tuesday—Second Conference on Industry-Science Teaching Relations.

Thursday—Science Club and Science Fair Project Exhibit.

N.S.T.A. Open House

The officers and staff on N.S.T.A. will hold open house for members and guests of the societies participating in this cooperative program, 4:00-6:00 P. M. Tuesday, December 28, N. E. A. Building, 1201 Sixteenth Street, N. W., Washington, D. C.

NSTA TO DEVELOP CONSULTANT SERVICES

Members of NSTA are well acquainted with the *Packets of Science Information for teachers.* Seven Packets have been distributed since October, 1946, and they are now distributed four times a year. Items actually included in the Packets are selected from a much larger number which are submitted for consideration. An N.S.T.A. evaluation committee of science teachers examines and rates all of these supplementary teaching materials in terms of their suitability, acceptability, and effectiveness in science teaching. Only the best items go into the Packets.

The Packet Service has now developed to the point where an opportunity to participate in the production of supplementary teaching aids can be offered to science teachers themselves. Many companies, associations, groups, and individuals desire the expert help of capable science teachers in planning and developing materials and services for the improvement of science instruction. They are, of course, willing to pay for such help.

Inquiries and requests concerning Consultation Service are coming to N.S.T.A. in increasing numbers. Therefore, the executive secretary has been asked to prepare and maintain a file of qualified N.S.T.A. consultants on supplementary teaching materials. Please regard this as YOUR INVITATION to consider participating in this worthwhile activity. Bring it to the attention of others, too: your colleagues, your friends in research and industry, and all others who may possess the talents and breadth of experience needed for such work.

All interested persons should write the executive secretary of N.S.T.A., Robert H. Carleton, and send him rather comprehensive information on these points: (a) fields of interest and specialization; (b) background of experience in teaching, writing, editing, etc.; (c) particular competencies and types of service they could render; (d) additional information pertinent to the problem. Do not be too modest in supplying this information;

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Old Chums

"If I die first," my old chum paused to say,
"Mind! not a whimper of regret;—instead,
Laugh and be glad as I shall.—Being dead,
I shall not lodge so very far away
But that our mirth shall mingle.—So, the day
The word comes, joy with me."

James Whitcomb Riley.

Parts of poems from the pen of James Whitcomb Riley adorn the walls of the beautiful Riley Room in the Claypool Hotel at Indianapolis, Indiana. Here on November 26, 1948 the annual banquet of the Central Association of Science and Mathematics Teachers took place as a part of the convention program. Those who attend these banquets remember them well because they mark high spots in the social activities of the conventions, as they occur each year.

Certainly those in attendance at this year's banquet will remember it as "tops" in the history of Central Association affairs. It was a gay occasion; the food was good; the program was excellent; and the array of officials and guests in evening dress at the speaker's table added charm and dignity to the occasion. There was but one thing missing in this delightful setting—our *Old Chum*, Emil Massey, wasn't there.

Everyone felt Emil's absence! Everyone felt his presence! Because in the days that USED-TO-BE he met everyone at the informal receptions preceding and following these banquets. He was the kind of a "guy" that once you knew him, you were drawn to him. I heard many people say at this convention, "I felt very close to Emil Massey." And at moments during the annual banquet when the attention of those in attendance might have shifted momentarily from the speaker, I am sure that running through their minds again and again recurred this thought, "Our *Old Chum* is not with us tonight."

Professor Emil L. Massey died on November 9, 1948, following an illness which began a few days before. Professionally, he was known as Director of Senior High School Science for the Detroit Public Schools and Associate Professor of Education at Wayne University, Detroit. Prior to his educational experiences, he was chief chemist for the Detroit Copper and Brass Company. In 1924, he left the field of industry to begin his teaching career at North High School, Detroit; in 1926 he was promoted to the head of the science department at Central High School, Detroit; later he became supervisor of high school science, and in 1944 was made director of the science program in the senior high schools of Detroit.

EMIL L. MASSEY

Hosts of professional friends were made through his educational experiences in Detroit and through membership in the National Education Association, Central Association of Science and Mathematics Teachers, American Association for the Advancement of Science, and National Science Teachers Association (Director, 1944). He was a member of Sigma Phi Sigma and Phi Delta Kappa. He received degrees from Tri-State, Michigan, and Detroit Universities.

Since his death occurred almost concurrent with the convention of the Central Association of Science and Mathematics Teachers, and since he served this organization so faithfully as a director in 1941-44, and as its president in 1944, for years to come, those in attendance at these affairs will think as did the poet, James Whitcomb Riley, about "The Land of Used-to-Be."

"Beyond the purple, hazy trees
Of Summer's outmost boundaries;
Beyond the sands—beyond the seas—
Beyond the range of eyes like these,
And only in the reach of the
Enraptured gaze of Memory,
There lies a land, long lost to me,—
The land of Used-to-Be!"

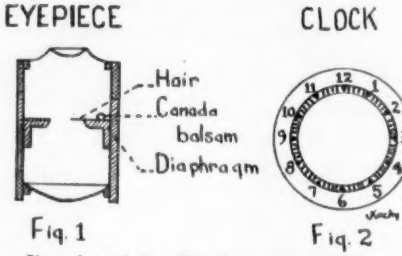
Continued on Page 188

Microscope Techniques for Locating Objectives

LEE R. YOTHERS
Rahway High School
Rahway, New Jersey

HIGH school biology students are usually inexperienced operators of microscopes. Frequently, they wish to question the instructor regarding a specimen, or part of the specimen, which they are studying. Many have difficulty in describing the exact location of the objective. It is equally troublesome for them to follow directions and find tiny details. Much of this confusion may be reduced by using two simple, but effective, techniques. Other teachers have used the techniques described below. This article, then, is directed to those not familiar with the devices to be described below.

The first method mentioned is widely used under many circumstances. Therefore, no extensive description will be given. By using the hour arrangement on the face of a clock, students may be taught to describe a location as "Three o'clock" etc., instead of saying, "up there" or, "near the lower side." See Fig. 2.



Figs. 1 and 2. The hour arrangement for locating an objective can be used, but the end of a hair is often better.

THE SECOND method is more effective. An examination of the microscope's ocular will show it to be composed of two lens screwed into the ends of a metal cylinder. Between the lens may be found a diaphragm. Its purpose is to limit the observer's field of view. If a short piece of hair is fastened, using a drop of Canada balsam, to the upper side of the diaphragm, it will be plainly visible through the ocular. The hair should be straight and extend beyond the diaphragm approximately half the distance of the aperture. The accompanying Fig. 1 may be studied for the arrangement. As the hair remains fixed in position, the slide may be moved over the stage until the desired position is directly opposite the free end of the hair. This simple device saves time for both the student and the teacher. In addition, it eliminates uncertainty as to whether the desired object is being observed. It is well worth the effort needed to make this installation in the microscope.

DESIGN FOR SCHOLARSHIPS

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and girls write to: Bausch & Lomb Science Scholarships, University of Rochester, Rochester, N. Y., and to Science Clubs of America, 1719 N Street, N. W., Washington 6, D. C., for details of the Eighth Annual Science Talent Search for the Westinghouse Science Scholarships.

How One Teacher Does It

Some Techniques Presented by

DR. PAUL BRANDWEIN

Forest Hills High School
Forest Hills, New York

1. R. W. of Ashtabula, Ohio and E. B. of Southampton, N. Y. write to ask what sort of program might be appropriate for a science assembly.

Some programs that have been successful are those put on by commercial comanies such as—

a) "The House of Magic," General Electric Co.
Excellent dramatic demonstrations include radio activity, sound, light, etc.

b) "Sound," The Bell Telephone Co.
New inventions in communication. There is audience participation.

c) "Adventures in Science," Westinghouse Corp.
Similar to (a) above; there is a good variety of demonstrations in different areas. There is audience participation.

Write to the educational division of each company for a date. All the demonstrations are performed by the companies' representatives.

Other programs that stimulate audience participation are—

a) A group program with a panel of students or teachers, or both. Questions are submitted by the students.

b) Quiz program on "Cancer." The Cancer Society of your neighborhood may furnish prizes.

c) A club program. Students from the various clubs demonstrate their projects.

d) An assembly on "Body Functions." An amplifier augments the heartbeat so that it can be heard in the audience; students show the effect of rapid exercise by bubbling exhaled breath through a solution containing 1 cc of 0.1 N NaOH phenolphthalein before and after exercise; students show lung capacity by displacing water in a respirometer, etc., etc.

Do you have certain assembly programs that have been successful for you? Others would like to hear about them. Send them to me for publication in "The Science Teacher."

2. Do you have trouble making the idea of separations of chromosomes concrete?
Take an insulated double electric wire. Cut a four inch length and poke a hole between the two halves which are, of course, joined by rubber down their entire length. Now place two strings in the hole so that by pulling on each string the wire will separate into two halves. As you pull slowly, metaphase and anaphase positions of the chromosomes (the wire) will be shown on the spindle (the strings). A rubber band between the two strings will make the spindle fiber continuous.

3. Have you sent for the booklet "The Story of Blood." It is well-written, illustrated, and useful for reference. It is free and may be obtained from the Metropolitan Life Insurance Co., 1 Madison Avenue, New York.

4. Have you tried *Sedum* and its relatives for epidermal cells? It is easy to strip. Merely break a leaf in half and pull. The epidermus peels off easily.

5. The lower epidermis of *Rhoeo* is pink. Under the microscope, the epidermal cells are pink, the guard cells are full of green chloroplasts.

Send me a description of techniques you use. They will be published under your name.

CHATS WITH SCIENCE TEACHERS

Continued from Page 175

preted? By all means—especially as to the natural history of Palestine, the customs of the ancient Hebrews, the "moral lessons from nature" that still remain good precepts after two thousand years and more. Let the young folks do most of the thinking on these lessons; their points of view may be more modern than your own.

Shall thoughts of creed and sect be interjected? Shall questions on the "literal truth" of the printed text be raised? Not unless the one who seeks to start the argument is prepared to explain—literally—four-footed fowls (*Lev.* 11:20), singing turtles (*Psalms* 104:12), or cows that are caught with fish hooks (*Amos* 4:2). Leave such matters to the theologians!

SCIENCE PROBLEMS

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In practically all cases, except for a few large city high schools, only one of these additional courses was offered by any one school. A large majority of the schools reported no additional offerings over and above the usual general science, biology, chemistry, and physics.

As far as can be judged from the titles of the additional courses it appears that many of them have been designed to meet the needs of those students who cannot satisfactorily pursue the traditional courses. In the sense that they are adaptations of the traditional courses they may be regarded as attempts to meet the needs of the pupils for a general education.

There appears to be an urgent need for an intensive study of the methods used by the larger high schools to identify and guide the talented students so as to incorporate these methods into the programs of an ever-increasing number of the medium and small high schools.

The problems as given in this paper are tentative and incomplete. They are based on a preliminary examination of the reports which have been received up to the time of this meeting. These reports represent an incomplete return of the sample which was planned for this study. The necessary additional returns will be sought when the schools open this fall. Plans are now in progress for careful tabulations of all the returns. The full report of the study should be available in the spring of 1949.

AUTO MECHANICS COURSE

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THUS the year's work in auto mechanics here at Fieldston has provided a wealth of laboratory experience for the student in the handling of tools and equipment, in development of mechanical techniques, and in a first hand study of the makeup and functioning of automotive assemblies. He has acquired a valuable background of reading in simple straightforward texts to supplement the laboratory work, and has made a collection of pseudo-engineering drawings as a course

notebook.

It seems to me that the value of such a course as this lies in the development of an awareness of things mechanical, an appreciation of mechanical precision, and a practical application of fundamental principles of physics to a mechanical contrivance that has changed the course of our way of life, and, indeed, history itself.

THIS AND THAT

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established a High School Science Service for the teachers of that state. The purpose of this "Service" is to assist in the improvement of the sciences in Oklahoma; to assist in the location and identification of young people of promising scientific interests at the earliest possible time in their school careers; and to develop an improved university program for prospective teachers, with adequate in-service training provisions.

The writer was a guest speaker at their first annual science teachers conference held in November.

Korean Workshop

Miss Ruth Armstrong, a science teacher of Fort Smith, Arkansas, and one of 25 Americans acting as instructors in the Teachers Training Center at Seoul, Korea, writes that she conducts two secondary science classes and one in conversational English for over 100 of the 200 teachers enrolled in this term's workshop. The Korean government pays all the expenses of these teachers, invited from all its provinces. An intense interest is shown and they seem very eager to learn as much as possible about American ways.

Retired

Alfred R. Lincoln, Springfield, Mass.
Frederick H. Rea, Patterson, N. J.
A. C. Stevens, General Electric Co.

Deceased

Gordon B. Brankle, Indianapolis.
C. A. Stiteler, Philadelphia.
Emil Massey, Detroit.

Research

Mrs. Ida K. Langman of Philadelphia is on a year's leave of absence doing research work in Mexico.

PERIODIC CHART

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of each chemical symbol and title heading on the transparency. By lighting these small lamps, any symbol may be made visible in the color of the light behind it. With all the panel lights turned off, the plexiglas appears as an ordinary wall chart. As the various lights are switched on, the symbols appear either individually or in groupings to show the relationships between elements having an equal number of outer shell electrons, elements making up the different periods, or elements comprising the non-metals, heavy metals, light metals, and inert gases. Finally, all lights may be illuminated simultaneously to present the complete periodic table differentiated into its various groups by the colors of the lights themselves.

A SMALL remote-control box serves this main panel with flexible connecting cables. Two lengths of multi-conductor cable containing color-coded pairs of insulated number 22 copper wire were satisfactory for this purpose. One hundred ten-volt, 60 cycle AC power is directed to the primary of a step-down transformer[5] within the control box. This reduces the line voltage to the 6-volt value needed to illuminate the light bulbs on the panel board. The switch in this input line provides a master control for the entire system. The remote control box contains all the switching controls needed to produce the different lighting combinations desired. Operating procedure merely consists of first throwing on the master switch to energize the transformer and switching circuits. One of the six rotary switches acts as a selector and the operator may choose any one of the five lighting arrangements he desires to use. The following light arrangements are possible: 1. All lights. 2. Each light, separately. 3. Rows. 4. Columns. 5. Four groups representing any of the following: (a) heavy metals, (b) light metals, (c) non-metals, (d) inert gases.

The pedagogical value of the electric peridic chart may be summed up as follows:

1. Mere presence of this equipment in the

4—Drake Manufacturing Company, Chicago, Illinois.
5—Specially built by Standard Transformer Corporation, "Stancor", Chicago, Illinois.

lecture room assures its early use by the instructor.

2. Introduction of the periodic story affords an early opportunity for the study of chemistry's heritage (Prout, Dobereiner, De Chancourtois, and others).
3. The electric chart provides a continued opportunity to cite relationships between the electronic configurations of the elements and their respective activity.

LABORATORY FIRST

Continued from Page 158

IN THE FIELD of electrochemistry there are many interesting and valuable experiments. The apparatus need not be elaborate or expensive. Carbons from old flashlight cells with a piece of wire soldered to the brass cap make satisfactory electrodes. Two of these, a U-tube, and two or three dry cells are all that is necessary. Some experiments which may be done include the electrolysis of copper sulfate, sodium chloride, copper chloride, potassium sulfate, and potassium iodide solutions. The U-tube enables the student to keep the anode and cathode products separate. Although it may be impractical to test for the gases liberated in this apparatus, it is fairly simple to test for the other products. Litmus paper or solution, for acid and base, starch paste for iodine, and either litmus (bleaching action) or starch-potassium iodide paper for chlorine are sufficient. The teacher must be prepared to explain some results, especially those in which ions other than those in the compound are liberated. C. W. Bennett's "Modernized Teaching of Electrolysis", *this journal*, October, 1947, is an excellent reference.

WHEREVER possible, laboratory work should precede classroom discussion. By basing class work on results of the student's laboratory experiments their importance is emphasized to him and he comes to regard the laboratory as a place to learn rather than to play. Thus the laboratory becomes a vital part of the learning process and not just a place to demonstrate what has been discussed in class. This makes chemistry a live subject for the student. His interest is aroused early and kept.

CORRELATIONS WITH CONSERVATION

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Evaluation

In appraising the results of the correlated study of the unit, such questions as the following were raised.

1. Was the democratic process used in unit development or was it externally imposed?
2. Was correlation attempted only where it seemed natural and desirable?
3. Did the aims of the project have the sympathetic support of the teaching staff?
4. Was there a continuous program of cooperative planning on the part of all faculty members who participated in it?
5. Was there sufficient preliminary planning?
6. Did the unit grow out of the intimate interaction of teachers and students as they faced the social problem?
7. Did the unit organize pupil experiences around real life situations aimed toward meeting the personal and social needs of young adults?
8. Were activities determined by giving attention to the basic drives of the adolescent, to the discovery and development of his abilities and interests, and the satisfactory meeting of his felt needs? Were traditional subject matter fields and all material resources utilized to achieve this objective?
9. Did the functional development of skills, and the more purposeful study result in greater economy and permanency of learning?
10. Did the unit create in pupils an increasing ability and willingness for individual and social action?
11. Were adequate provisions made for individual differences?

Consideration is being given to the extension of the experiment to additional areas of social-function or adolescent needs in other grades of the school.

ATOMIC ENERGY

Continued from Page 156

and its by-products in medicine, in producing heat, in transportation, in changing the weather, and in direct synthesis of food for man and animals.

SOURCE MATERIALS

Audio-visual materials:

Charts: Old and new periodic classification charts.

Films: Atomic Energy, Electrons, One World or None, Principles of Electricity, Odd Phenomena of Science, Taking X out of X-rays.

Filmstrips: Atomic Bomb, Madame Curie, X-rays, How to Live With the Atom, World Control of Atomic Energy (sound).

Models: Atomic model, Trippanese planetarium.

Records: Exploring the Unknown—What is the Atom? We Are Many People.

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Yost, D. M., *The Rare-Earth Elements and Their Compounds.* John Wiley & Sons, 1947.

Book Shelf

WORKBOOK AND LABORATORY MANUAL (to accompany Basic Biology). Paul E. Kambly, University of Oregon. The Macmillan Company, New York City, 1948. 220 pp. 20x28 cm., illus.

Functions, relationships, and reasons are important in any study of biology and are much emphasized in the *Workbook and Laboratory Manual* to accompany *Basic Biology*. The book should serve to enhance the understanding of as well as an appreciation for living things.

The manual is designed to follow the text *Basic Biology* exactly and to guide the student in grasping the essential facts of the subject. Each problem in the manual is based on one chapter of the text. However, it may be used with other texts, if a good selection is available.

Provision is made for the better students and for those who want to make some further study of the subject by listing a number of references in which more detailed and technical information may be obtained.

Self testing exercises are generously interspersed among the material. At the end of each unit is a list of rather technical terms that may serve to review or recall important understandings.

RADAR PRIMER. J. L. Hornung, Supervisor of Radio-Electronics, Walter Hervey Junior College, New York City, formerly, Officer-in-Charge Naval Training School (Radar) Massachusetts Institute of Technology, Boston. McGraw-Hill Book Company, New York City, 1948. 218 pp. 13.5x20 cm. 123 illus. Price, $2.80.

What radar is and what it does and what it cannot do can be learned from *Radar Primer* by the average science student without a highly technical background in electronics. The book is outstanding for its simplicity. The technical vocabulary and scientific theory is kept to a minimum consistent with the requirements of the subject. It is written in a simple entertaining style with the emphasis on its peacetime applications.

Along with radar the book also includes such related areas as television, loran, and sonar for which it makes possible a good background of understanding. It may well serve as a basis for more advanced work.

The book is well-illustrated with many drawings and photographs that make clear essential principles and the method of operation. It contains helpful study questions at the end of each unit and a helpful bibliography.

A TEXTBOOK OF ENTOMOLOGY. Herbert H. Ross, Systematic Entomologist, Illinois State Natural History Survey, and Professor of Entomology, University of Illinois. John Wiley & Sons, Inc., 1948. 532 pp. 15½x23½ cm. $6.00.

The book is a well-organized text on the college level; it would also be useful as a high school reference book. The book is designed to give basic facts over the entire field of entomology.

The text opens with a concise, interesting history of entomology, treating it in terms of basic causes rather than as a mere list of dates and names. This is followed by a detailed summary of the Arthropods and with a treatment of external and internal anatomy. The segregation of insect physiology in a separate chapter permits a treatment of the subject by function, rather than by structure. Material is presented on the life cycles of insects including sections on embryology, food habits, etc.

A well-rounded view of the insect orders is given, covering some 200 pages. Illustrated keys are given to orders and common families. A geological history of insects, current aspects of ecology, control considerations, and paleontology are also covered.

The text is carefully illustrated on nearly every page. Chapters end with a bibliography, and a 16-page index is provided.

EMBRYOLOGY OF THE PIG. Bradley M. Patten, Professor of Anatomy in the University of Michigan Medical School. The Blakiston Company, Philadelphia, 1948. 352 pp., 15½x23½ cm., illus.

Embryology of The Pig is a well-organized text on the college level. In its third edition it has been brought up to date, though it is essentially the same as the earlier edition. The book has been reset to a greater page width. There are 186 completely labeled illustrations (containing 412 figures), six of which are in color.

The book is based on the pig embryo, although embryological phenomena as a whole has been especially stressed. The developmental process is presented throughout the book as a chain of events rather than as a series of selected stages. Paragraph subjects are introduced by key words in heavy face type.

Careful consideration has been given, among other things, to the reproductive organs; gametogenesis, germ layer foundation, the extra-embryonic membranes, and the structure of embryos from 9 to 12 mm. in length. The development of body systems, the body cavities, face, jaw, and teeth, and the histogenesis of bone is covered.

A 24-page bibliography, organized under 15 main headings is included. Both figure and page references are given in the 12-page index.

RUSSIAN-ENGLISH TECHNICAL AND CHEMICAL DICTIONARY. Ludmilla Ignatiev Callaham. John Wiley and Sons, Inc., New York City, 1947. 794 pp. 13½ x 19½ cm. $10.00.

The author who has had fifteen years as a specialist in reading and translating Soviet technical articles into English has prepared in the *Russian-English Technical and Chemical Dictionary* a very helpful work, particularly for the use of chemical engineers and research workers who already have a fair knowledge of Russian. Inorganic and organic chemistry, chemical technology, and chemical engineering are given the most complete coverage, but also included are the more frequently used terms in aeronautics, radio technology, meteorology, agriculture, medicine, physics, mathematics, and other pure sciences.

The book includes a general vocabulary consisting of all types of words that might appear in technical articles. Attention is given to non-technical words that acquire a different shade of meaning when used in a technical sense. The book is quite complete and also very practical for the worker in this field.

OLD CHUMS

Continued from Page 177

But we will never be content to associate our memories of Emil entirely with the land of *Used-to-Be*. For the spirit with which he

greeted everyone at these conventions, for his many acts of friendship, for the fact that we all looked upon Emil as an *Old Chum*, he will abide in the hearts of all of us forever. These conventions will be made *even brighter*, *even merrier*, and *even greater* because of Emil Massey. For Emil believed as did Riley, "But that our mirth shall mingle.—So, the day the word comes, joy with me."

Yes, the annual banquet in the Riley Room in 1948 was a joyful occasion; and as the years roll by, there will be others because the philosophy *Joy With Me* is eternal. This philosophy and the best wishes of Emil's many friends are extended to his good wife, Esther, and son, Dr. Robert Massey. *Joy With Me* will bring them enduring comfort and hope for the future.

OUR FRONTISPIECE

OUR frontispiece shows a model of basic elements of an atomic power plant, constructed under the supervision of scientists in the General Electric Research Laboratory and seen here with Dr. Kenneth H. Kingdon. One of the first physicists to isolate Uranium 235 from the natural element, Dr. Kingdon heads the atomic power division of the G-E laboratory.

The model is not full scale, and is quite schematic. At the left is the atomic "pile" where matter is transformed into energy by the splitting of uranium or another fissionable element. In his left hand Dr. Kingdon holds a model rod of this "fuel" material, while the striped rods projecting horizontally represent the control rods which would prevent the process from running away. A heat exchanging fluid would be pumped through the pile, thence to the heat exchanger on the right, where water would be turned to steam. This would then be used to drive turbines in the customary way.

The heat exchanger step is needed because anything entering the pile would become radioactive, and thus steam could not be brought directly from it. The radiations from the pile and the heat exchanger require that both be sealed in a capsule of concrete or similar protective material.

CONSULTANT SERVICE

Continued from Page 176

all of it is needed in order to compile a really useful list of potential consultants.

Problems likely to be encountered most often will be concerned with organization and design, vocabulary, concept difficulty, content, layout, instructional uses, and possible student activities. Arrangements for the actual services to be rendered, as well as the compensation for these services, are the responsibility of the person or agency seeking help and the recommended consultant. N.S.T.A. will, for a nominal fee payable to the association, handle all inquiries and preliminary conferences on consultation and will follow through to the point of making recommendations where possible. However, all fees for actual consultation are payable to the one or more consultants involved.

Persons interested in further information and details should send their inquiries to the N.S.T.A. executive secretary. Consultants may come from the N.S.T.A. membership from education, from industry, or wherever such talent may be found.

ELEMENTARY SCIENCE

Continued from Page 174

that can be managed. More desirable situations include the use of work benches, storage rooms, and storage cupboards. Science kits may be purchased which include equipment for doing many experiments. These are stored in a small box which is portable. Such kits may also be assembled by the ingenious teacher and the equipment stored in small boxes and used year after year. Many times the equipment may be brought to school by the children, relieving the storage problem. Teachers should be free to take children outdoors to observe actual situations. Duplicating actual situations that are found close to a school may not be desirable in view of the necessity of conserving space. Often the actual situation is a much better learning situation. An example of undesirable duplication is the construction of a device for showing soil erosion when the children can look out

(Continued in next issue)

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THE SCIENCE TEACHER 1948

AUTHOR INDEX


STUDENT MICROSCOPE
For beginning biology in high schools and colleges. Completely new design incorporates excellent features.
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